

LES Modeling of Lateral Dispersion in the Ocean

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PROGRESS REPORT FOR THE PERIOD OF PERFORMANCE FROM 09/09/09-12/07/09

LONG-TERM GOALS:

The long-term goal of this effort is to work in concert with DRI participants to develop scalable, physically based parameterizations for lateral mixing in the stratified ocean on scales of 0.1-10km that can be implemented in larger-scale ocean models. These parameterizations will incorporate the effects of local ambient conditions including latitude, mean stratification and mesoscale flows. Another ultimate goal is to develop a more comprehensive picture of horizontal and vertical mixing processes in the ocean in collaboration with other DRI participants.

OBJECTIVES:

The objective is to participate in the multi-year, concerted DRI effort of field observations, theoretical and numerical modeling on oceanic small-scale lateral dispersion. Mesoscale flows of interest include internal tides, near-inertial waves, ocean fronts and mesoscale eddies.

APPROACH:

As a numerical modeler, my approach consists of using my primary numerical tool, a highly optimized Boussinesq model that has been extensively used to study internal-wave and dispersion-related problems.

WORK COMPLETED DURING SECOND QUARTER:

During this period, I attended the DRI yearly meeting in Seattle. Joshua Jacobs, a PhD candidate who is also being funded by this grant, also participated in the Seattle meeting. Our efforts continue to be focused on understanding the characteristics of submesoscale vortex flows resulting from wavebreaking events. I have begun considering the impact of mesoscale vortices on submesoscale lateral dispersion. The initial flow consists of a field of spun up mesoscale turbulence. The flow is then forced as before with randomly placed (parameterized) wavebreaking events. I am currently examining the behavior of individual wavebreaking events placed in strain-dominated or shear-dominated regions.

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J. Jacobs showed that modeling the distribution of wavebreaking events as a Poisson process leads to much more energetic submesoscale fields. This can be explained by the fact that closely spaced vortices are more likely to interact, and hence to merge. This merging results in an inverse cascade to larger scales. Hence, less energy is available for transfer to dissipative scales. We are currently attempting to quantify the energy transfer to the mesoscale from the wavebreaking events.